irritation, denoted by pain in the head, flashes before the eyes, vomiting, cramps, and contractions of the extremities, etc. In such cases, it may be requisite to administer purgatives, and aconite, or veratrum viride; also to apply leeches behind the ears and cold to the head. In such case, venesection should generally be avoided as a dangerous measure, because it is liable to diminish the strength and weaken the action of the heart too much, while at the same time it increases the coagulability of the blood itself; unless, perchance, the patient's face is red and plethoric, the pulse full and strong, and even then a large quantity of blood should not be taken. In the analogous condition of the lower extremities, small or moderate venesections have often proved extremely useful in cases where the patient was red-faced and plethoric, the pulse full and hard, and the heart not obviously fatty. It is impossible to lay down many general rules for the treatment of this disease. The physician should make a special study of each case; its therapeutic indications should be anxiously sought for and carefully fulfilled by appropriate medication.

62 EAST TWELFTH STREET, Jan. 31, 1873.

ART. VII.—*An Inquiry into the Nature of the Yellow Fever Poison, with an Account of the Disease as it occurred at Governor's Island, New York Harbour.* By GEORGE M. STERNBERG, M.D., Brevt. Major and Asst. Surgeon U. S. Army.

THE literature of yellow fever is so extensive, and the facts recorded relative to the numerous epidemics which have occurred since the early settlement of this continent so numerous, and apparently so contradictory, that a "contagionist," or a "non-contagionist," a believer in the local origin, or in the invariable importation of the disease, can readily find material for a voluminous work in favour of his particular theory.

No theory, however, which does not explain all the well-attested facts can be considered satisfactory; and I believe it can be readily demonstrated, that the theory of a personal contagion giving rise to the disease on the one hand, or of its local origin from atmospheric and telluric influences on the other, are both untenable.

There are three agents, to one of which we must (in the present state of our knowledge) refer the poison, which, by its action upon the human system, produces yellow fever, viz.:—

(*a.*) A volatile inorganic matter.

(*b.*) A lifeless organic matter of the nature of a ferment, which, by catalytic action, is capable of transforming, otherwise (comparatively) harmless substances, present in the earth, or in the atmosphere, into the materies morbi of yellow fever.

(*c.*) A living germ, capable, under favourable conditions as to heat, moisture, etc., of rapid self-multiplication, and acting, either directly, or indirectly by catalytically transforming other substances into the efficient cause of the disease.

That the poison is of the latter nature, is, I conceive, the only theory consistent with the observed facts in regard to the origin and propagation of the disease, and that upon it all the otherwise contradictory facts are reconcilable. In support of this I will first submit a few concise propositions which seem to me capable of proof, and will then briefly discuss these propositions and the legitimate inferences to be drawn from them:—

1. *The yellow fever poison is not an emanation from the persons of those sick with the disease.*

2. *It is not generated by atmospheric or telluric influences.* A certain elevation of temperature is, however, necessary for its multiplication, and its rapid increase is promoted by a moist atmosphere, and probably by the presence of decomposing organic matter.

3. *The poison is portable in ships, goods, clothing, etc., and a minute quantity is capable of giving rise to an extensive epidemic.*

4. *Exposure to a temperature of* 32° *Fahrenheit completely destroys it.*

5. *It may remain for an unknown length of time in a quiescent state,* when not subjected to a freezing temperature, or exposed to the conditions necessary to its multiplication, *and may again become active and increase indefinitely when those conditions prevail.*

6. While liability to the disease, and its severity when contracted, depend to a certain extent upon age, sex, temperament, previous habits, and acclimation, they also depend to a great extent upon the degree of concentration of the poison—that is to say, the larger the dose, the greater the probability of an attack, and the greater its severity.

If the first three propositions be proven, viz., that the poison is portable, that a small quantity may increase indefinitely, independently of the human body, and that it is not produced by atmospheric influences, then the necessary inference is, that it is capable of self-multiplication, which is a property of living matter only.

In support of the first proposition I shall confine myself to the facts as they came under my own observation at Governor's Island, New York harbour, during the epidemic which occurred in the summer of 1870.

It will first be necessary to give a sketch of the topography of the island.

Governor's Island has an area of sixty-three acres, and, at the time of the epidemic under consideration, had a population of 722, of whom 157 had the fever, and 49 died. It will be sufficiently accurate for our purpose to consider the island a square, having one side facing Brooklyn, and the opposite side looking towards New York. On the Brooklyn side, in the order named, commencing at the northeast corner, were the following buildings: A one-story frame tenement, with basement kitchens, occupied by the families of four married soldiers; next the post hospital;[1] next a frame building, occupied as quarters for the band; next a two-story brick building, used as quarters for about eighty music boys, who were on the island for the purpose of instruction; next a row of one-story frame tenements occupied by company laundresses.

There were no buildings upon the south side of the island, but at the southeast corner is Castle William, which, at the time referred to, furnished quarters for about one hundred and fifty general prisoners, undergoing sentence of courts martial.

On the New York side of the island is the arsenal. Two officers, with their families, resided here, and about ten or twelve men were employed about the place.

On the side of the island facing up the East River were the quarters for officers. These are two-story frame buildings, and contained at this time five families, numbering in all eighteen persons.

Considerably to the New York side of the centre of the island is located Fort Columbus. The garrison consisted of three companies, numbering together about two hundred and fifty men.

The facts in disproof of the personal contagiousness of yellow fever, as it occurred at Governor's Island, were as follows:—

1. The disease first made its appearance in the frame house at the northeast corner of the island. It speedily moved through all the buildings on the east side and the adjacent officers' quarters on the north side, but it did not invade Castle William, Fort Columbus, or the Arsenal. In the infected locality but very few escaped, and in all one hundred and fifty cases occurred. In the uninfected portion, which contained more than two-thirds of the whole population, but three or four cases occurred, and all of these had probably been for a greater or less time in or about the infected buildings on the east side. Communication between persons living in different parts of the island was unrestricted in the earlier part of the epidemic; but afterward, I believe, the soldiers in Fort Columbus and in Castle William were prohibited from visiting the infected locality.

2. After more than half the music boys had taken the fever, the remainder were removed from their barracks to the quarters inside Fort Columbus, adjoining those occupied by the permanent companies. These boys had unrestricted communication with the remainder of the garrison, and a number of them were taken sick with the fever shortly after their removal inside the fort. (These cases had evidently contracted the disease before their removal.) Yet the garrison of Fort Columbus escaped the disease.

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[1] A brick building, with a one-story frame ward on the south side of it, which ward was used for the reception of patients.

3. Before the island was placed under quarantine, a number of persons from New York visited their friends who were sick with the fever in the house where the disease first made its appearance, some remaining in the house more than twenty-four hours, and some for a shorter time. Thirteen of these persons were taken sick with yellow fever after their return to New York, and ten of them died. They were scattered about in different parts of the city, and a number of them were admitted to Bellevue Hospital, yet no one in New York contracted the disease from them.

4. One hundred and fifty yellow fever patients were removed from Governor's Island and placed under my care at the quarantine hospital in the lower bay. At this place there were ten persons, including the nurses, at the hospital, and the family and servants of the superintendent, who had never had yellow fever, not one of whom contracted the disease.

From these facts it seems clear that the disease, as it occurred at Governor's Island, was not personally contagious. A vast array of evidence from other sources might readily be presented in further proof of the non-contagious nature of yellow fever, but this is a point which is now generally admitted by the best authorities.[1]

It is true that many observations have been recorded which seem to support the belief that the disease has been communicated in certain instances by personal contagion, but I shall endeavour to show presently that these facts are readily explainable upon another hypothesis.

The supposition that the materies morbi of yellow fever is an inorganic substance, produced by certain atmospheric or telluric influences, or a combination of both, is untenable for various reasons. First, it cannot be reconciled with the portability of the poison, of which there is ample evidence.[2]

We might admit the possibility of such a substance being transported in sufficient quantity in the cargo of a vessel to infect the atmosphere (if a volatile substance) in the immediate vicinity of the wharf where the cargo was discharged, for a limited time ; but in this case the disease should be most widespread at its first appearance, and the area of infection decrease as the poison became dissipated, and upon the removal of the infected articles the epidemic should terminate. It is well known, on the contrary, that all epidemics have had a small beginning, and that the number of cases and the area of infection increases from day to day until cold weather puts an end to the disease or the absence of individuals susceptible to it limits the number of cases. Recurring to the epidemic at Governor's Island, it is difficult to conceive that any local causes could have existed on one part of the island, capable of producing an extremely fatal form of disease, which did not exist to an equal extent on the other portions where there was no sickness, or which did not exist along the wharves and river-streets of New York and Brooklyn to a far greater extent. In the latter localities the elements of heat and moisture were present to as great an extent at least, and the additional leg of the tripod, upon which believers in the local origin of the disease lay most stress, viz., filth or organic matter in a state of decomposition, was abundant in numerous localities in the two great cities, while the little island, under strict military surveillance, with an ample force of prisoners on constant police duty, was at all times kept as clean as possible. The only unpleasant odour which assailed the nostrils in going from one end of the island to the other was that of chlorine, from the little dabs of chloride of lime which were regularly scattered along the dry and clean open brick drains. The advocates of the local origin of yellow fever can point to many instances where no clear history of importation can be produced. The epidemic at Governor's Island is such an instance.[1]

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[1] For proofs of non-contagion, see La Roche on Yellow Fever, vol. ii., pp. 236 to 566.

Dr. Thomas, after thirty years' practice in New Orleans, from 1818 to 1848, declares that he never saw or heard of a well-established example of the communication of yellow fever to any person in the country by patients who had contracted the disease in the city during a visit while the epidemic was prevailing. The same exemption proved constant when unacclimated residents of the city who fled, but nevertheless sometimes sickened and died, or recovered in the country, after having lived in the same houses and slept in the same beds with the country people.—*Bennet Dowler, Tableau of the Yellow Fever of* 1853.

[2] For proofs of the portability, see "A System of Medicine" (Reynolds), vol. i., p. 678, for case of bark Heckla, by which yellow fever was brought from Cuba to Swansea, Wales.

Also, Circular No. 1, Surgeon-General's Office, Washington, D. C., June 10, 1868, pages 17 to 39, for detailed account of the introduction of the disease to various points on the Gulf of Mexico, during the summer of 1867.

Also, Annual Report of the Health Officer of the Port of New York for 1872.

[1] There is a strong probability that the germs which gave rise to the disease at Governor's Island, first lodged upon a point of land which is only uncovered at low tide, and which projects into the water just in rear of the house where the first cases occurred. The current at ebb tide sets from the Brooklyn side in such a direction as to strand anything thrown into the water in the neighbourhood of Atlantic docks upon the point of land referred to. It is known that certain vessels from infected ports discharged cargo at these docks a short time before the disease made its appearance. There is no evidence that any cases of fever occurred upon these vessels while on their voyage or after their arrival in port. When we consider, however, that the crew of a sailing-vessel is small, that the sailors on vessels from infected ports are often protected by having had a previous attack of the disease, and lastly, that it is the interest of master and crew to conceal or misrepresent the facts in regard to any sickness that may have occurred to avoid detention at quarantine, it cannot be accepted as proven that a certain ship did not bring infected articles into port because no evidence of sickness during the voyage can be elicited. In this connection we may refer to the cases reported in the annual report of the Board of Health of the city of New Orleans for 1872 as being very instructive.

But, on the other hand, numerous instances can be given where the disease has clearly and unmistakably resulted from direct importation. Even were a thorough investigation made in every case, many possible avenues by which the poison might reach a large city must necessarily escape attention.

A further argument against the local origin of the yellow fever poison is found in the fact that epidemics of the disease occur at irregular and uncertain intervals. Several years often elapse, even in those southern cities where the disease occurs most frequently, without the appearance of a single case, whereas the local causes which might be supposed to produce it recur every summer. In diseases of recognized local origin, such as intermittent and remittent fevers, each recurrence of the season during which the necessary conditions prevail for the production of the miasm, is marked by the occurrence of new cases, and this continues to be so every succeeding year unless some change occurs in local conditions, *e. g.* the drainage or filling up of swamps. Again, a very significant fact is, that the disease occurs most frequently in commercial cities, while towns in the same latitudes and under like conditions as to location, etc., but having no commerce, very rarely suffer from it.

The early cases in a majority of epidemics are also known to occur in the vicinity of the wharves and in the persons of those whose usual employment is upon and about ships.

If we suppose that the yellow fever poison is produced by the catalytic action of a lifeless organic ferment upon certain of the products of decomposition, we are still at a loss for a source of supply for the ferment, as it is shown not to be given off from the bodies of those sick with the disease nor to be produced by local causes.

The amount imported in any particular instance could only have a certain limited effect, as the changes produced in another substance by a lifeless organic ferment do not in any case with which we are acquainted increase the amount of the ferment itself, and a certain degree of concentration is required to produce any effect. For example, one part of diastase will effect the transformation of 100 parts of starch into sugar, or a given amount of pepsine will effect the transformation into albuminose of a certain limited quantity of muscular fibre. If, however, the ferment be capable of self-multiplication, or, in other words, be endowed with life, as in the case of the yeast plant, then its action is only limited by the supply of the material acted upon, that is, so long as the essential conditions as to temperature, etc., prevail.

We are thus, it seems to me, reduced by exclusion to the supposition that a specific living germ is the cause of yellow fever, either by its direct action upon the human system or indirectly by its power of catalytically transforming other substances, which without its action are harmless, into the materies morbi of the disease. By which of these methods it acts there seems to be at present no way of determining. In either case the substance taken into the system is itself destroyed, at least in so far as its hurtful properties are concerned. Let us now inquire whether the "germ theory" will account for all the observed facts in regard to the origin and propagation of the disease. That the effective cause of yellow fever is completely destroyed by a freezing temperature is admitted. There is no portion of the United States, I believe, where frosts do not occur occasionally during the winter months, consequently the germ is not a native of our shores, but an exotic whose permanent habitat is in warmer latitudes. As would be expected, it is brought most often to those places which are nearest to, and in most intimate commercial relations with, its permanent home. But it does not follow because a freezing temperature kills the germ, that after a widespread epidemic in one of the southern cities, the first frost must destroy all the germs existing in those localities. On the contrary, it is highly probable that in warm cellars, in unventilated apartments, and perhaps under the sediment which accumulates at the bottom of drains and ditches, germs may be preserved over winter and perhaps for an indefinite number of years, and that, when again subjected to influences favourable to their multiplication, they may regain their activity and increase rapidly in number. While most of the severe epidemics in this country may be traced to direct importation, there have been numerous minor epidemics in the Southern cities, and "sporadic cases" occur nearly every year in New Orleans and Charleston, which it has been impossible to account for in the same way. While in some of these instances a careful investigation might have brought to light evidence of importation, I think we must admit that the probability is strongly against it in many cases. It is this fact which has made so many experienced physicians and accurate observers strenuous advocates of the local origin of the disease in the cities mentioned.

The posibility of the preservation of the germs in the ways indicated fully accounts for those cases[1] which it is noticeable occur only in the latter part of the season.

The type of the disease in these minor epidemics and sporadic cases is usually less severe than in an epidemic resulting from importation. In a very able report supporting the germ theory, published in the transactions of the Howard Association of the city of Charleston, for the year 1871, the idea is advanced that the germs, being exotic, deteriorate after a certain length of time when removed from their native clime, and particularly so in their reproductive power. As analogous cases, the West India tobacco and the long staple cotton of the seaboard are instanced. The former, if raised in the United States in successive crops from a single importation of seed, soon loses its original characteristics. The latter, if treated in the same manner in the upper country, is said to degenerate to short staple.[1]

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[1] For an instance in which the germs of yellow fever were clearly preserved from year to year, see "The History of Yellow Fever on the Spanish War-ship Numancia." By S. Oakley Van Derpoel, M.D., Health Officer, Port of New York, reported in "The Medical Record," No. 168, pp. 562–569.

We have next to explain those cases in which the evidence of personal communication of the disease has been so strong as to appear incontrovertible. This is readily done upon the supposition that the individual suffering from the disease carried, from the infected locality where he contracted it, a sufficient number of germs about his person (in the clothing, or adhering to the surface of the body, the hair, or whiskers) to give rise to the disease in others who by their intimate personal relations with him were peculiarly exposed to this source of infection. A very few germs carried in this way would, of course, if they met with favourable conditions for their rapid propagation, soon establish a new centre of infection. But if such conditions did not exist only those directly exposed to the influence of the transported germs would suffer—as, for instance, the nurse who took care of the patient, or the laundress who washed his clothing. The last proposition stated is, that (other things being equal) the liability to an attack, and severity of the symptoms, vary directly in proportion to the quantity or degree of concentration of the poison to which an individual is subjected. This proposition may not be capable of absolute demonstration, but is strongly supported by a variety of facts, and may perhaps be considered a necessary deduction if the preceding propositions be accepted as true.

It is noticeable in every epidemic that there are certain localities where the disease seems to be particularly malignant, attacking nearly every one living in the vicinity and proving fatal in a large proportion of the cases. At Governor's Island the house where the disease first made its appearance was such a locality. The cases were all of a severe type. On the contrary, many of the cases which occurred among the music boys in the South Battery were of a mild character, and early in the epidemic a number occurred in which the patient was not taken into hospital at all, but reported in person at "sick call" every morning. I also noticed that a greater proportion of those who slept in the second story escaped the disease and the cases were of a milder character than among those occupying the ground floor.

Again, in certain wide-spread epidemics at New Orleans and Charleston, those who had been supposed to be exempt, either by reason of acclimation or a previous attack, have suffered as well as the unacclimated stranger. It seems probable, therefore, that, in a sufficiently diluted form, the poison may be taken into the system without producing its specific effects unless the person be particularly susceptible to its influence. But when all the conditions for its multiplication are most favourable, it may become so concentrated and potent that neither acclimation nor a previous attack protects from it.

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[1] If the report referred to had an extensive circulation, I should hardly consider it requisite to publish this paper, as the germ theory is there supported in a satisfactory manner, and to some extent by the arguments I have used; I arrived at my convictions independently, however, and had purposed embodying them in a paper for publication before I saw this report.

An inquiry concerning the atmospheric influences most favourable for the rapid increase of the yellow fever germ would develop many points of interest, but does not come within the scope of the present paper. I may, however, remark that a certain continued elevation of temperature is the only condition which has been proved to be absolutely essential. That a moist atmosphere and the presence of decomposing organic substances constitute favourable conditions seems highly probable. Yet I believe that the latter element has been very much overrated. At any rate severe epidemics have occurred where this condition was apparently reduced to a minimum. Witness the epidemic at Governor's Island in 1870; at Fort Hamilton and Bay Ridge in 1856, and at Gibraltar on various occasions.

There is strong evidence, however, that the presence of decaying timbers, such as are found about all old frame houses, ships, and wharves, is favourable in some manner to the preservation and increase of the germ.

The germ theory as herein advocated may be stated as follows:—

Yellow fever is an infectious disease, produced by the action upon the human system (directly or indirectly) of a specific living germ, which finds the conditions essential to its multiplication, external to the human body. The germ is an exotic in the United States and is destroyed by a freezing temperature, but may sustain its vitality for an indefinite length of time at temperatures too low for its increase, and will regain its reproductive power when subjected to a continued temperature of about 80°.

If this theory be adopted, the proper steps to be taken for the prevention of the disease are apparent. They may be briefly stated as follows:—

To prevent the importation of germs.

To destroy them by such means as are in our power, wherever their presence may be suspected.

To remove all unprotected persons from their influence, when their presence at any point is ascertained.

ART. VIII.—*Death from an attempt at Criminal Abortion by the Introduction into the Abdominal Cavity of a wire 17½ inches in length.* By T. GAILLARD THOMAS, M.D., Prof. of Obstetrics and Diseases of Women and Children in the College of Physicians and Surgeons, New York.

ON the morning of Dec. 20, 1872, I was called to see Mrs. X., æt. 32 years, native of the United States, wife of a physician, and mother of two children. She stated that during her pregnancies she had suffered so much